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FINAL REPORT
SURVEYS AND INVESTIGATIONS PROJECTS

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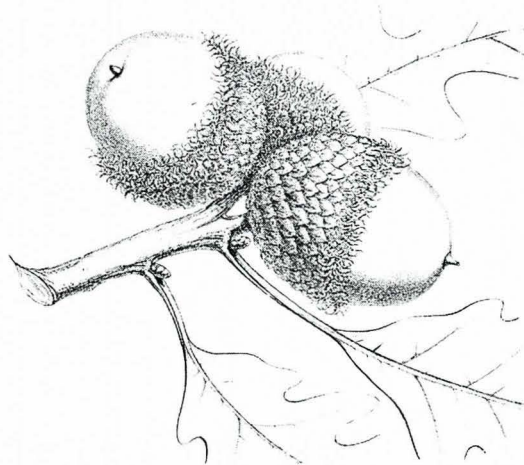
Federal Aid Project No. W-13-R-34 (1980)

STUDY NO. XXIII: Mast Yields in Missouri

Job No. 2: Evaluation of mast survey

By

Donald M. Christisen



Larry R. Gale, Director

Charles A. Purkett, Jr., Assistant Director

Dean A. Murphy, Chief, Wildlife Division

MISSOURI DEPARTMENT OF CONSERVATION

Dan F. Dickneite
P-R Coordinator

April 1, 1981

Bill T. Crawford, Supt.
Wildlife Research Section

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FINAL REPORT
SURVEYS AND INVESTIGATIONS PROJECTS

STATE OF MISSOURI

Project No. W-13-R-34 (1980)

Study No. XXIII

Job No. 2

Study No. XXIII: Mast Yields in Missouri

Job No. 2: Evaluation of mast survey

ABSTRACT

Foresters of the Missouri Department of Conservation rated acorn yields of 54 oaks on a 4-point system. Comparisons were made to a 9-point rating system calibrated to actual yields. The 4-point system for rating acorn yields was satisfactory but accuracy might be improved with use of permanent sites.

A postal card mast survey of foresters is a less intensive alternative to the mast survey appraisal of trees and sufficient for detecting the extremes in yields.

Annual evaluations of acorn yields even when limited to the Ozark and Break Regions of the state, likely would be adequate for correlating mast-consuming wildlife responses to sizes of acorn food crops.

Mast evaluations by year and major regions are shown for the period 1949-1980. Acorn yields are evaluated for the period of 1960-1980 according to revised regions.

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Project No. W-13-R-34 (1980)

Study No. XXIII

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Study No. XXIII: Mast Yields in Missouri

Job No. 2: Evaluation of mast survey

Objective:

Analyze the mast survey data obtained by ocular appraisals and compare with direct sampling of yields for improvement of the system.

Procedures:

An ocular appraisal of 1979 acorn yields was made on 9 oaks on the Rudolf Bennitt Wildlife Area (Boone County) by 9 Missouri Department of Conservation foresters in early September; on 18 oaks on the Indian Trail State Forest (Dent County) by 2 Missouri Department of Conservation foresters; and on 27 oaks on the Carman Springs Wildlife Refuge (Howell County) by 6 Missouri Department of Conservation foresters in late August. Later personnel of the University of Missouri (Columbia) Entomology Department measured the yields of acorns/m² of crown area for each of the oaks appraised (Myers, 1978). The foresters appraisals on which the mast survey index is calculated was compared with the acorn production rating index of Myers.

A postal card survey of mast crops was conducted simultaneously with the established and more intensive ocular mast survey in 1980 (Christisen, 1980) to compare results. Foresters checked off yields according to four categories of abundance for mast groups for each county. The data were grouped by counties in the same regions as those used for the mast survey of individual trees. Likewise, the opinions were treated in the same manner as the tree data culminating in an index.

An arbitrary value was assigned each yield category: heavy, 3; medium, 2; light, 1; and none to few, 0; the sum of the products represented the production index. A maximum index of 300 points was possible. Expressed as a formula:

$$(H \div T \times 3) + (M \div T \times 2) + (L \div T \times 1) = I \text{ where}$$

H = Total postcards (counties) citing heavy yields
M = Total postcards (counties) citing medium yields
L = Total postcards (counties) citing light yields
T = Total postcards (counties)
I = Index

Procedures (cont'd):

A regional state map was developed by regrouping the counties into more meaningful units for evaluating mast production, squirrel and turkey harvest data (Fig. 1). The new map is based on zoogeographic, topographic, soils, and vegetative features. Acorn data for the period 1960 through 1980 were recalculated to conform to the new regions (Appendix).

Tabular summaries of the mast evaluations by year and major regions used originally were compiled for the entire period of the surveys 1949 through 1980 (Appendix).

Findings and Analysis:

The Foresters of the Missouri Department of Conservation rated acorn yields for 54 oaks representing 3 different locations (Figure 2). The actual yield of acorns was calculated per m² of crown area and categorized according to the Myer's 9-point acorn production rating index (Table 1), and the 4-point rating system of the Missouri Department of Conservation compared with it by personnel of the Entomology Department, University of Missouri - Columbia.

The Bennitt Area oaks exhibited a wide range of yields (Table 2) but the Carman Springs and Indian Trail areas produced few acorns (Tables 3 and 4) and only two foresters rated oaks on the latter area. Dr. William H. Kearby, Professor of Forest Entomology was pleased with the foresters interest and ability in rating yields. Most foresters were conservative in their ratings. Kearby pointed out that the 4-point evaluation system was very close to the Myers 9-point system. The major bias in the 4-point system as evaluated by Kearby was the lack of permanent sample areas.

Consideration should be given to limiting the annual mast survey to acorns alone and to those counties with 20% or greater of the land area in commercial timber. Mast is less important to wildlife in counties outside of the major forest areas. Acorns are a universal food to forest wildlife. Hickory nuts, and to some extent walnuts, are important to squirrels and tend to relieve the feeding pressure on acorns. If hickories are to be included in future surveys, they should be evaluated in August before squirrels can remove the crop. Information on the black walnut crop can be obtained from Hammons Products of Stockton. Hammon's samples the walnut crop statewide. Pecans are as important as hickories but have very limited distribution.

The postal card mast survey (Figure 3) brought 105 county evaluations from foresters on a 4-point check system of heavy, medium, light and few or none yield categories. There was relative close agreement of indices in some mast groups of the opinion (card) survey and the ocular (tree) survey (Table 5). In the event cost of conducting the annual mast survey becomes a factor, it might be feasible to use a postcard survey alone to at least know when big yields occur or near failures happen.

Findings and Analysis (cont'd):

The mast survey began in 1949, a natural succession to a Pittman-Robertson Federal Aid program acorn study that had begun in 1947 and ended in 1954 (Burns et al., 1954; Christisen, 1951; Christisen, 1955). The early years of the annual mast survey were experimental in nature, dependent on varied sources of information. Since the survey relied on volunteer help, it was limited to oaks, hickories, pecans, walnuts, and butternuts all of which could be appraised in the same time span. Also, the nut trees, because of their wide spread distribution (Christisen, 1978) and importance to game animals as producers of fall and winter foods were chosen for the survey (Christisen, 1965; Christisen, 1969; Christisen, 1979; Christisen and Korschgen, 1955). Indiana (Allen, 1952) had begun a mast survey earlier which was supportive of their squirrel research program. A squirrel research program had begun in Missouri in 1947; the annual mast survey was viewed as a valuable adjunct to this program.

The survey form and method have remained virtually unchanged over the 32 years. Each species of nut tree and 4 categories of yield are shown on the form along with certain guidelines for appraising the yield (Figure 6). This form was used by foresters and biologists of the Missouri Department of Conservation who evaluated yields of at least 50 nut producing trees in each county assigned. Eligible trees were those having a d.b.h. of at least 8 inches with dominant or co-dominant crowns.

District and farm foresters formed the core of the survey crew in the early years and as the staff grew in size, the foresters eventually conducted the entire survey of the state. Postal card poll of U.S. Forest Service Rangers, Missouri Department of Conservation towermen, area, and refuge managers as to nut yields (Figure 4) was used to supplement the more comprehensive foresters survey. Coverage in the earlier years was confined mostly to the Ozark region where the personnel and state areas were located.

Squirrel hunter cooperators rated hazlenuts, hedgeball, persimmon, mulberry, and wild grape yields in addition to nut yields beginning in 1950 but the highly variable results of the poll brought discontinuance after 1958 (Figure 5). The U.S. Forest Service rangers and M.D.C. personnel participated in the postcard poll from the beginning through 1953 but lack of uniformity and agreement with the forester's survey ended this phase of the survey.

An earlier forecast of nut yields seemed practical by conducting a mid-summer survey since nuts were large enough to be seen with the aid of binoculars by then. M.D.C. wildlife research biologists began making mid-summer mast surveys in 1953 in conjunction with a furbearer sign count. The scope of this survey included all the major zoogeographic regions in the state representing 40-50 counties and about 7,000 trees.

The objective of the survey was to gain crop information some two months in advance of the fall mast drop. After three years of trial,

Findings and Analysis (cont'd):

it appeared there was no particular advantage in this mid-summer survey; in some instances it did not reflect an accurate evaluation of the fall crop because of premature nut drop. Also, the economy in conducting it was lost when the furbearer sign counts were discontinued.

Thereafter, beginning in 1956, the biologists conducted mast surveys in the fall to supplement the foresters data and sample counties outside of the forestry districts. The staff of farm and district foresters was large enough by 1964 to sample most of the regions in the state without additional help.

Translating the annual mast survey data into some set of numerical standards for comparative purposes necessitated the development of an indices system as set forth in procedures. Attempts were made to describe the yields by identifying each range of indices within the system with an adjective. This attempt at a word description of the size of crop was never satisfactory, particularly with differences in the range of indices among the nut groups and in the absence of the indices system being calibrated directly to actual nut yields.

Seldom did any one nut group score 200 or more on a scale of 300 points; nor only on rare occasions did a nut group have an index below 50. Therefore, for purposes of this report it seemed best to let yields stand on the index figure alone, subject to the reader's interpretation, with the observance, the higher the index the better the yield.

There was bias in evaluating yields among nut groups beyond the bias of judgment appraisals. The survey was conducted usually within the period of August 15 - September 30. This long time span in itself allowed for bias in the timing of the survey by the observer. Premature nut drop, maturation time, amount of foliage, open grown trees, size of trees, elevation, exposure, etc. were a few of the many variables which affected yields of trees selected by the observer. Also, the size of the nut was a factor in appraisals which led to bias, particularly among nut groups such as black walnut vs. shingle oak acorns. Hickory nuts, a preferred squirrel food, often times were consumed before the survey period ended.

Ocular evaluations of nut yields were biased but when the survey was conducted by experienced foresters, the "highs" and "lows" in mast production were detected but the degree of yields in the great middle area of "medium" were ill defined.

The basic area unit of the survey was the county but because of the small sample and great variability in yields locally, the smallest unit considered in the survey was zoogeographic region. Even at that level, the information was not practical for wildlife management. Therefore the 8 zoogeographic regions were grouped into 2 major regions, prairie and forest (Figure 7). This classification grouped counties simply by the presence or absence of forest cover, with the exception of

Findings and Analysis (cont'd):

the Mississippi Lowland counties included with forest on the basis of geographic location.

Later, as forest inventory and certain wildlife biological data became available, it was evident that the counties might be re-aligned into more meaningful regional units. The basis of the revision was the zoogeographic region but with modifications based on the amount of commercial timber, vegetation, glaciation, topography and soil types. Commercial timber is the core of the forest land which produces most of the mast and constitutes the prime squirrel habitat and much of the better wild turkey habitat. Counties having 20% or more of its land area in commercial forests (Spencer and Essex, 1976) was included in the forest region, those with less in the prairie region, excluding the Mississippi Lowland as a separate entity.

This realignment on the basis of commercial timber brought 2 western counties into the forest region but excluded 3 counties from the Western Ozark border and the Forest region. It also added 8 counties north of the Missouri River, originally a part of the Northeast Riverbreaks (prairie) to the Forest region. Likewise 1 county from the Mississippi Lowlands was added to the forest region because of topography and amount of commercial timber.

The major regions were further sub-divided with respect to soils, vegetation, forest cover and climate. The prairie was sub-divided into 2 units, northern prairie (glaciated) and western prairie (non-glaciated). The Forest region was sub-divided into the Breaks (hilly, loess, silt loam soils) and the Ozarks (non-glaciated, cherty limestone to stony).

The Breaks have particularly fertile timber sites and on the basis of soil types and location constitute 2 mini-divisions, Lindley Breaks north of the Missouri River and Union Breaks on the south.

Essentially the Ozarks include the Ozark Plateau and Western Ozark Border of the Zoogeographic Region with mini-divisions Ozark Border, Ozark West and Ozark East. Geographic, geological and vegetative differences were basis for the mini-divisions. Two counties, originally in the Northern and Eastern Ozark Border were included with Ozark West and 1 county from the Western Ozark Border was included with Union Breaks. As indicated earlier 2 counties were added to Ozark Border from Western Prairie but 3 counties were lost to Western Prairie. Except for the loss of 1 county to Ozarks East, the Mississippi Lowland region remained unchanged but as a separate entity (Figure 8).

The yield indices by species group are shown for 2 original regions by years as well as for the mast composite of oaks, hickories, walnuts and pecans. Also, the black oak and white oak groups of acorn indices are shown according to the more recent revisions of the Breaks and the Ozarks regions by year (Appendix).

Recommendations:

The annual mast survey has furnished a rough estimate of the size of the nut crop in Missouri for 30 years. A refinement in the system by selecting permanent sample sites likely would improve accuracy and is recommended if the survey is to be continued. Other considerations were enumerated in paragraph 3 of the preceding section.

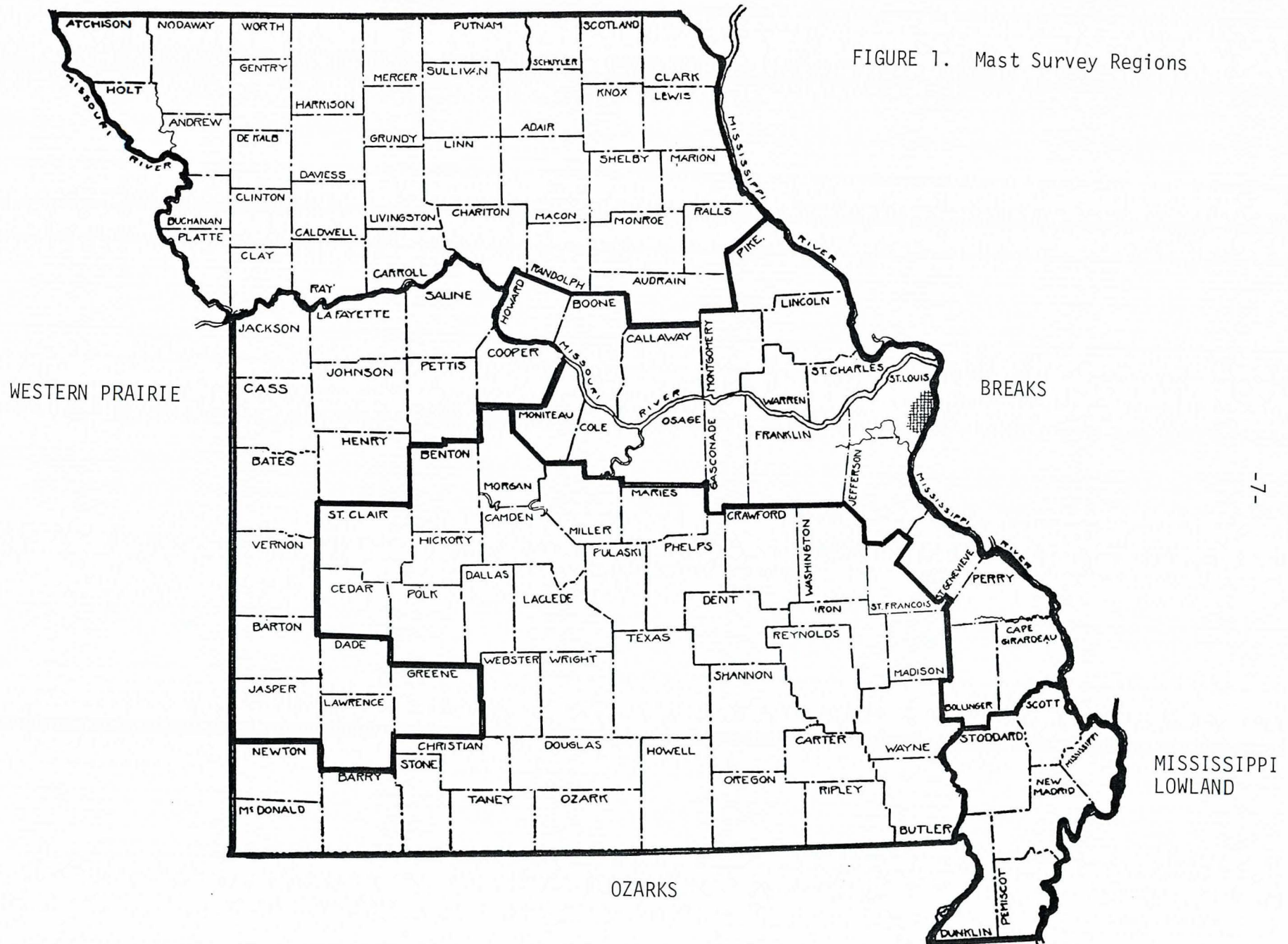
It is suggested that the direct sampling technique developed by Myers be used to calibrate ocular appraisals on the 4-point acorn yield rating system.

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NORTHERN PRAIRIE

FIGURE 1. Mast Survey Regions



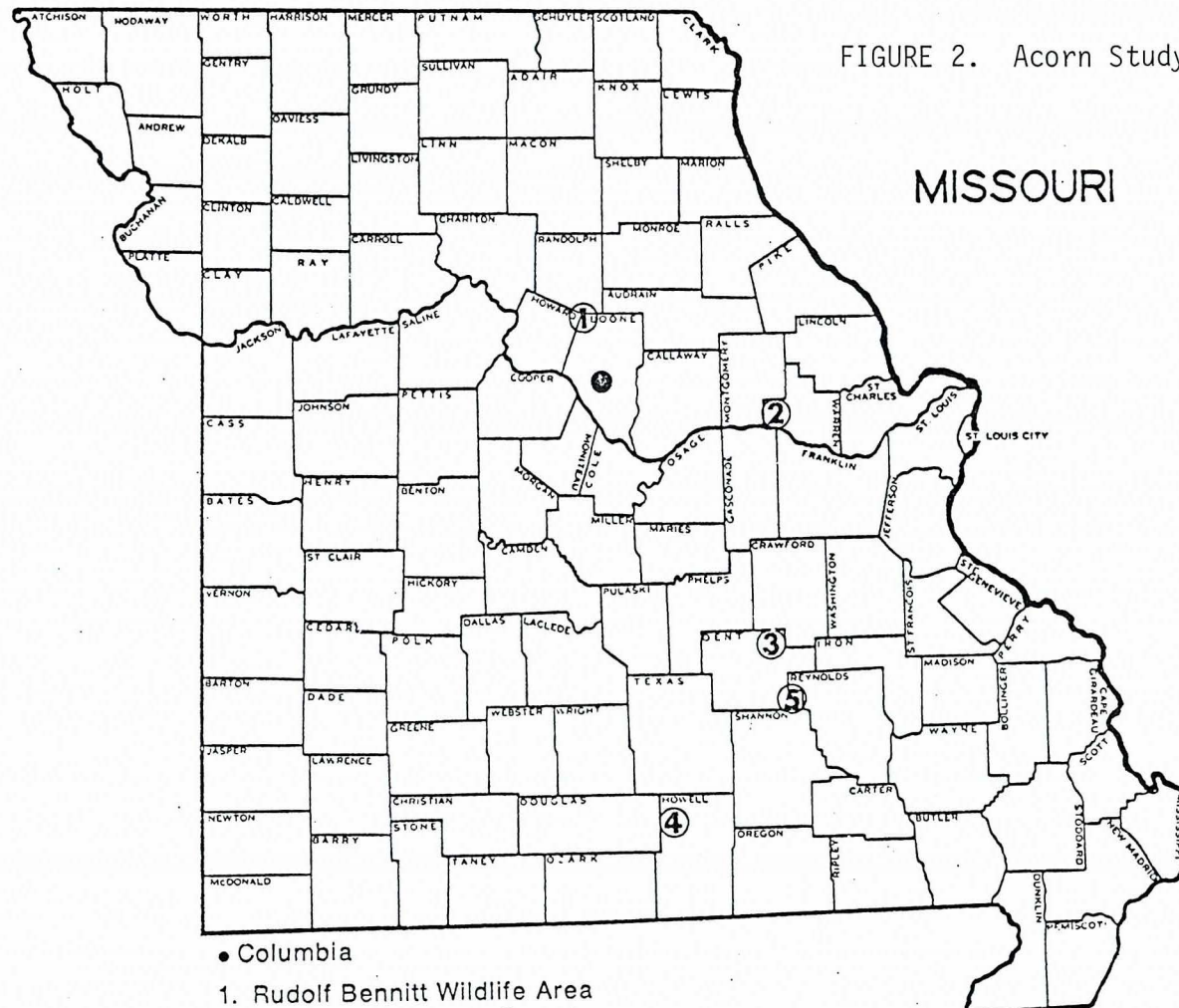


FIGURE 2. Acorn Study Areas

MISSOURI

- Columbia
- 1. Rudolf Bennett Wildlife Area
- 2. Daniel Boone State Forest
- 3. Indian Trail State Forest
- 4. Carman Springs Wildlife Refuge
- 5. Sinkin Experimental Forest
(Myers, 1978)

September 19__

County__

MAST REPORT CARD

NUT YIELDS	HEAVY	MEDIUM	LIGHT	FEW
Hickory				
Pecan				
Walnut				
Black oak gr.				
White oak gr.				
Nut crop-overall				
Squirrel population				
Turkey population				

Forester's Name__

COMMENTS:

FIGURE 4

TOWERMAN'S MAST REPORT

Name (towerman)__

Tower__ County__

1. The mast crop in my tower locality is (excellent, good, fair, or poor)_____ this year.
2. The black and red oak group produced a (heavy, medium, or light)_____ acorn crop.
3. The white oak group produced a (heavy, medium, or light)_____ acorn crop.
4. Does this year's mast crop appear to be enough for a good winter carry-over of wildlife dependent upon this source of food?_____

Remarks:

FIGURE 5

SQUIRREL MAST CROP ABUNDANCE

(Check Yield That Best Describes Each Kind of Food)

KIND OF MAST	YIELD OF MAST CROP			
	FEW	LIGHT	MEDIUM	HEAVY
Acorns, Black Group				
Acorns, White Group				
Hickory Nuts				
Walnuts				
Pecans				
Hazel Nuts				
Hedge "Apples"				
Persimmons				
Wild Grapes				
Mulberries				

Observer _____ Date: _____ County: _____

RELATIVE ABUNDANCE MAST

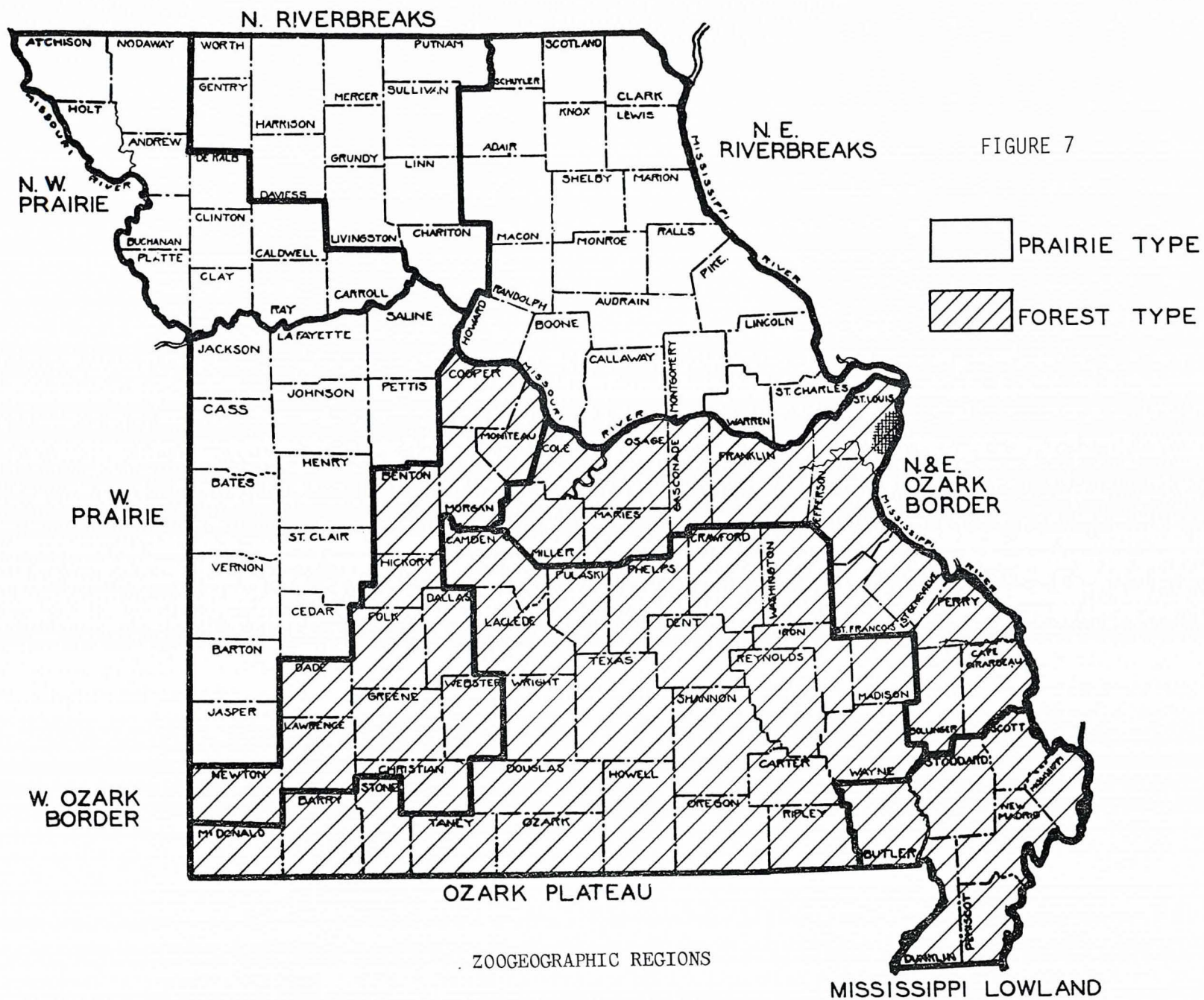
Heavy - Nuts in clusters evenly distributed. Entire tree bearing nuts.

Medium - Some clusters with scattering of single nuts evenly distributed over the entire tree
or clusters of nuts only on half of the crown.Light - Scattering of single fruits over entire tree or a few clusters in $\frac{1}{4}$ of the crown.

Few to None - Less than two dozen nuts on entire tree.

MAST PRODUCING TREES (Use tally marks:)	RELATIVE ABUNDANCE			
	Heavy	Medium	Light	Few to None
Black Walnut (<i>Juglans nigra</i>)				
Butternut (<i>Juglans cinerea</i>)				
Pecan (<i>Carya pecan</i>)				
Scaly or Shagbark Hickories (Shellbark, <i>Carya laciniosa</i> ; Shagbark, <i>C. ovata</i>)				
Smooth Bark & others (Bitternut, <i>Carya cordiformis</i> ; Pignut, <i>C. glabra</i> ; Red, <i>C. ovalis</i> ; Black, <i>C. texana</i> ; Mockernut, <i>C. tomentosa</i>)				
Bur Oak (<i>Quercus macrocarpa</i>)				
Chinquapin Oak (Chinkapin, <i>Quercus muhlenbergii</i> ; Dwarf Chinkapin, <i>Q. prinoides</i>)				
Post Oak (<i>Quercus stellata</i>)				
Swamp White Oak (<i>Quercus bicolor</i>)				
White Oak (White, <i>Quercus alba</i>)				
All Other White Oaks (Overcup, <i>Quercus lyrata</i> ; Swamp Chestnut, <i>Q. prinus</i> ; etc.)				
Black Oak (<i>Quercus velutina</i>)				
Blackjack Oak (<i>Quercus marilandica</i>)				
Northern Red Oak (<i>Quercus borealis</i>)				
Pin Oak (<i>Quercus palustris</i>)				
Scarlet Oak (<i>Quercus coccinea</i>)				
Shingle & Willow Oaks (<i>Quercus imbricaria</i> ; <i>Q. phellos</i>)				
Others of Red Oak group (Shumard, <i>Q. shumardii</i> ; Southern Red or Turkey Foot, <i>Q. falcata</i>)				

Remarks:



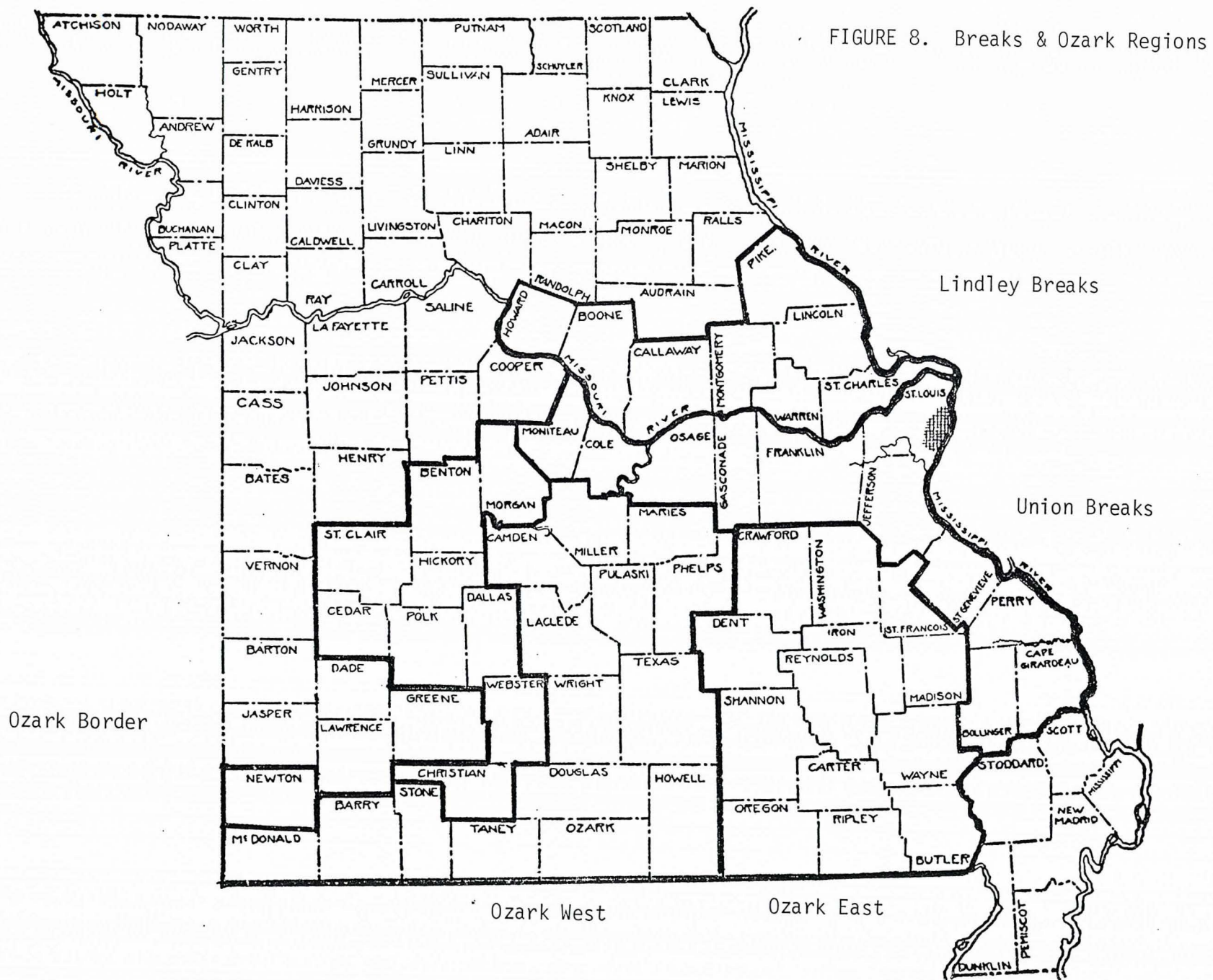


TABLE 1
ACORN PRODUCTION RATING INDEX

Rating	Acorn Abundance
1	Few to none.
2	Poor: sparsely scattered acorns.
3	P+ or F-
4	Fair: evenly distributed single acorns and small clusters.
5	F+ or G-
6	Good: evenly distributed acorns with numerous small and medium sized clusters.
7	G+ or H-
8	Heavy: numerous medium and large sized clusters throughout the crown.
9	Bumper: very high acorn density over a large percentage of the crown.

TABLE 2

Rudolf Bennitt Wildlife Area
Mast Inventory 9/5/79

The Missouri DNR foresters inventoried only Plot B, since Plots A and C had only "few to none" based on the rating system. Only 9 trees were rated.

Plot B

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
3	NRO	9			
4	WO	5	4		
5	WO	7	2		
7	NRO	9			
8	NRO	9			
9	BO		1	7	1
10	WO	9			
12	BO	1	1	7	
15	BO		1	6	2

^{a/} NRO - Northern Red Oak, WO - White Oak, and BO - Black Oak.

Myers rating for the following trees: 3, 5, 7, 8, 10 (few to none),
4 (light), 9, 12, 15 (medium).

TABLE 3

Carman Springs
Mast Inventory 8/28/79

The Missouri DNR foresters inventoried Plots A, B, and C. In each plot 9 trees were rated.

Plot A

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
1	BO	3	3		
3	BO	5	1		
9	BO	3	3		
18	PO	5	1		
26	BO	2	3	1	
33	BO	2	4		
45	BO	1	4	1	
48	WO	6			
56	BO	2	3	1	

^{a/} BO - Black Oak, PO - Post Oak, and WO - White Oak.

Myers rating for the following trees: 1, 3, 9, 26, 33 and 45 (light), 18 and 48 (few to none), and 56 (medium).

Plot B

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
7	SO	6			
13	BO	5	1		
15	WO	4	2		
22	SO	6			
26	SO	4	2		
30	WO	6			
32	SO	6			
38	BO	5	1		
47	BO	5	1		

^{a/} BO - Black Oak, SO - Scarlet Oak, and WO - White Oak.

Myers rating for the following trees: 7, 13, 15, 22, 30, 32 and 38 (few to none) and 26 and 47 (light).

Table 3 (cont'd)

Carman Springs

Plot C

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
2	SO	1	1	2	2
5	SO	3	1	2	
7	SO	3		3	
13	BO	6			
14	SO		1	3	2
18	WO	6			
27	SO		3	3	
28	WO	6			
30	SO		3	1	2

^{a/} BO - Black Oak, SO - Scarlet Oak, and WO - White Oak.

Myers rating for the following trees: 2 (heavy), 5, 14, and 30 (medium), 7 and 27 (light), and 13, 18, and 28 (few to none).

TABLE 4
Indian Trail State Forest
Mast Inventory 8/30/79

The Missouri DNR foresters inventoried only Plots A and B, since Plot C had only "few to none" based on the rating system. Only 9 trees were rated.

Plot A

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
3	BO	2			
8	WO	2			
13	WO	2			
14	SO	2			
38	BO	2			
39	BO	2			
46	WO	2			
48	BO	2			
51	BO	2			

^{a/} BO - Black Oak, SO - Scarlet Oak, and WO - White Oak.

Myers rating for the following trees: 3, 8, 13, 14, 38, 48, and 51 (few to none), 39 (light).

Plot B

Tree No.	Species ^{a/}	Foresters' Ratings			
		Few to None	Light	Medium	Heavy
2	SO	2			
5	BO	2			
12	SO	2			
18	SO	2			
20	BO	2			
31	SO	2			
32	SO	2			
35	BO	2			
41	WO	2			

^{a/} BO - Black Oak, SO - Scarlet Oak, and WO - White Oak.

Myers rating for the following trees: 2, 5, 12, 18, 20, 32, 35, and 41 (few to none) and 31 (light).

TABLE 5. Comparison of Ocular and Opinion Indices
1980 Mast Crop

	No. Trees	Ocular Index	Opinion Index	Number Postcards (Counties)
<u>PRAIRIE</u>				
Hickory	536	33	21	49
Pecan	133	122	104	26
Walnut	601	27	16	49
Black Oak Group	1250	113	224	50
White Oak Group	1043	61	56	50
Composite	3563	97	114	49

<u>FOREST</u>				
Hickory	771	62	37	54
Pecan	99	99	61	18
Walnut	811	50	38	52
Black Oak Group	2439	175	194	53
White Oak Group	2181	108	115	54
Composite	6301	121	111	56

<u>STATE</u>				
Hickory	1307	50	29	103
Pecan	232	112	86	44
Walnut	1412	40	28	101
Black Oak Group	3689	179	209	103
White Oak Group	3224	93	86	104
Composite	9864	112	112	105

COMPOSITE MAST YIELD INDEX*

Year	PRAIRIE		FOREST		STATE	
	Sample	Index	Sample	Index	Sample	Index
1949	1182	196+	2625	144	3807	160
1950	548	98+	4736	132	5284	128
1951	237	210++	3557	181	3794	184
1952	--	--	4706	114	4706	114
1953	106	172++	3962	145	4068	145
1954	1249	119	2917	103	4166	108
1955	369	80	4226	96	4595	95
1956	3261	135	4829	136	8090	135
1957	3123	114	9826	109	12949	110
1958	4253	89	8278	128	12531	115
1959	3561	157	11102	103	14663	116
1960	3350	140	8360	124	11710	129
1961	3625	93	8124	130	11749	121
1962	3837	150	10785	137	14622	141
1963	3939	118	11684	95	15623	100
1964	1998	205	10221	163	12219	170
1965	2104	139	9450	143	11554	142
1966	2298	157	8622	134	10920	139
1967	2767	93	8311	152	11078	138
1968	2224	175	7512	133	9736	143
1969	2448	113	9347	131	11795	127
1970	2981	180	10138	151	13119	158
1971	3124	120	9581	137	12705	133
1972	3022	157	8971	123	11993	132
1973	1906	99	9116	106	11022	105
1974	1942	150	9296	135	11238	138
1975	2153	134	8844	113	10997	117
1976	2279	101	11034	118	13313	115
1977	2118	105	9178	148	11296	140
1978	3019	123	7347	152	10366	143
1979	2898	113	5813	120	8711	118
1980	3563	97	6301	121	9864	112

* Includes acorns, hickory nuts, pecans, walnuts and butternuts.

+ Northeastern and Northern Riverbreaks only

++Northeastern Riverbreaks only

STATE MAST YIELD INDEX

Year	WALNUT		PECAN		HICKORY		WHITE OAKS		BLACK OAKS	
	Sample	Index	Sample	Index	Sample	Index	Sample	Index	Sample	Index
1949	495	208	34	138	731	178	1193	149	1351	144
1950	817	124	16	50	838	87	1959	163	1654	110
1951	502	238	12	183	728	206	1292	205	1254	128
1952	533	49	17	106	741	71	1506	115	1902	150
1953	620	210	40	40	552	119	1446	132	1410	144
1954	537	98	2	50	564	109	1486	102	1577	117
1955	633	180	29	173	874	121	1603	73	1456	63
1956	858	148	62	158	1430	84	3405	180	2329	97
1957	1833	158	117	211	2027	101	4432	52	4540	150
1958	1514	95	96	110	2039	61	4417	100	4465	161
1959	1786	132	63	105	2583	83	5296	140	4935	102
1960	1624	91	90	186	1949	114	4334	149	3713	128
1961	1944	115	150	116	1928	89	3989	80	3738	163
1962	2263	141	242	136	2198	90	5189	153	4730	150
1963	2219	86	180	102	2389	77	5353	98	5482	120
1964	1933	205	102	175	1811	157	4149	174	4224	155
1965	1832	97	138	144	1779	101	4036	159	3769	166
1966	1775	144	135	123	1693	118	3429	128	3888	156
1967	2064	132	158	165	1707	97	3527	145	3622	151
1968	1739	146	89	100	1795	145	3187	149	2926	134
1969	2106	135	143	130	2304	139	3493	133	3749	111
1970	2174	149	217	150	2078	108	4242	167	4408	177
1971	2187	115	201	165	2007	68	3955	130	4355	174
1972	2133	130	221	191	1945	120	3614	111	4080	153
1973	2161	146	169	118	1974	138	3121	63	3597	97
1974	1827	129	137	114	1903	99	3886	201	3485	94
1975	2023	144	158	130	1982	128	2997	90	3837	117
1976	2169	101	210	113	2192	80	4162	125	4580	130
1977	2050	172	225	161	1939	126	3323	118	3759	148
1978	2069	110	165	152	1660	123	3310	179	3162	137
1979	1591	139	111	203	1663	117	2649	94	2697	125
1980	1412	40	232	112	1307	50	3224	93	3689	179

MAST YIELD INDEX PRAIRIE REGION

Year	WALNUT		PECAN		HICKORY		WHITE OAKS		BLACK OAKS	
	Sample	Index	Sample	Index	Sample	Index	Sample	Index	Sample	Index
1949										
1950+	74	77	10	20	82	57	225	121	157	101
1951										
1952										
1953	14	236	--	--	17	200	49	149	26	162
1954	163	112	--	--	159	106	420	91	507	148
1955	33	170	--	--	51	165	185	64	100	39
1956	378	121	42	143	588	53	1633	174	620	118
1957	480	141	71	259	584	144	1375	73	613	141
1958	523	79	57	128	850	52	1685	63	1138	160
1959	501	173	5	91	752	125	1473	169	813	155
1960	620	114	66	197	608	134	1349	139	708	164
1961	627	71	82	117	677	108	1482	66	757	149
1962	696	132	106	125	604	87	1684	180	747	153
1963	614	59	154	106	709	87	1491	136	971	167
1964	501	238	49	176	433	199	608	194	407	191
1965	498	50	66	123	368	79	716	182	456	221
1966	529	129	83	135	427	173	681	155	578	174
1967	639	87	54	33	486	74	830	94	758	115
1968	496	186	45	89	446	191	740	197	497	124
1969	605	105	62	98	550	122	673	117	558	110
1970	760	164	108	120	444	150	1002	204	667	192
1971	724	97	114	191	508	69	892	105	886	176
1972	744	142	174	208	435	134	861	133	808	197
1973	539	125	49	163	372	124	482	26	464	117
1974	445	132	44	130	373	119	608	197	472	135
1975	576	126	65	172	496	158	449	105	567	131
1976	582	77	83	121	353	41	699	117	562	141
1977	545	145	105	173	383	85	535	52	540	118
1978	952	94	124	151	395	85	871	162	677	129
1979	635	125	111	203	587	111	801	102	764	104
1980	601	27	133	122	536	33	1043	61	1250	113

MAST YIELD INDEX FOREST REGION

Year	WALNUT		PECAN		HICKORY		WHITE OAKS		BLACK OAKS	
	Sample	Index	Sample	Index	Sample	Index	Sample	Index	Sample	Index
1949										
1950	743	129	6	100	756	85	1734	168	1497	111
1951										
1952	523	49	17	106	741	71	1506	115	1902	150
1953	606	209	40	40	535	116	1397	132	1384	144
1954	374	92	2	50	405	110	1066	107	1070	102
1955	600	181	29	173	823	118	1418	74	1356	65
1956	480	170	20	190	842	105	1772	185	1709	90
1957	1353	165	46	137	1443	83	3057	42	3927	151
1958	991	104	39	85	1189	68	2732	122	3327	161
1959	1285	115	41	112	1831	66	3823	129	4122	92
1960	1004	78	24	154	1341	104	2985	153	3006	120
1961	1317	135	68	115	1251	93	2507	104	2981	150
1962	1567	145	136	144	1594	91	3505	141	3983	150
1963	1605	96	26	23	1680	72	3862	87	4511	110
1964	1432	193	53	164	1378	143	3541	171	3817	133
1965	1334	114	72	164	1411	107	3320	154	3313	166
1966	1246	151	52	104	1266	99	2748	121	3310	153
1967	1425	152	104	233	1221	107	2697	161	2864	154
1968	1243	129	44	111	1349	130	2447	135	2429	136
1969	1501	147	81	154	1754	145	2820	136	3191	111
1970	1414	141	109	179	1634	96	3240	155	3741	174
1971	1463	124	87	130	1499	68	3063	137	3469	173
1972	1389	124	47	143	1510	116	2753	104	3272	132
1973	1622	152	120	100	1602	142	2639	70	3133	94
1974	1382	128	93	108	1530	94	3278	202	3013	87
1975	1447	158	93	100	1486	118	2548	88	3270	113
1976	1587	110	127	109	1839	87	3463	127	4018	128
1977	1505	182	120	150	1546	136	2788	132	3219	153
1978	1117	124	41	156	1265	114	2439	185	2485	140
1979	956	149	--	--	1076	120	1848	90	1933	133
1980	811	50	99	99	771	62	2181	108	2439	175

ACORN YIELD INDEX - BREAKS & OZARKS

Year	BLACK OAK GROUP		WHITE OAK GROUP		ALL OAKS
	Sample	Index	Sample	Index	Index
1960	3132	118	3079	154	135
1961	3206	164	2771	98	133
1962	4089	151	3774	142	147
1963	4656	109	4082	86	99
1964	3924	150	3696	168	159
1965	3508	162	3545	155	158
1966	3356	145	2918	119	133
1967	2849	155	2786	156	156
1968	2594	137	2617	136	136
1969	3054	111	2757	134	122
1970	3631	174	3246	152	164
1971	3522	172	3109	133	154
1972	3248	141	2819	101	123
1973	3073	92	2908	62	77
1974	2688	85	3194	201	147
1975	3224	115	2583	86	102
1976	3925	131	3609	125	128
1977	3081	151	2559	125	139
1978	2537	137	2513	177	157
1979	1824	132	1784	84	108
1980	2602	176	2320	100	140

ACORN YIELD INDEX - BREAKS

Year	BLACK OAK GROUP		WHITE OAK GROUP		ALL OAKS
	Sample	Index	Sample	Index	Index
1960	486	68	628	135	106
1961	679	120	636	78	100
1962	905	152	988	135	143
1963	1009	113	1172	97	104
1964	730	160	891	165	163
1965	774	160	980	168	165
1966	867	127	800	101	115
1967	776	155	894	131	142
1968	709	135	967	151	174
1969	583	109	570	113	111
1970	954	152	955	140	146
1971	765	180	792	118	149
1972	582	118	698	95	105
1973	461	94	560	68	80
1974	513	97	753	198	157
1975	687	132	636	83	109
1976	839	147	944	141	144
1977	618	146	653	110	128
1978	558	106	644	133	120
1979	498	110	563	74	91
1980	572	167	518	41	108

ACORN YIELD INDEX - OZARK

Year	BLACK OAK GROUP		WHITE OAK GROUP		ALL OAKS
	Sample	Index	Sample	Index	Index
1960	2646	126	2451	158	142
1961	2527	175	2135	104	143
1962	3184	151	2786	144	148
1963	3647	109	2910	82	97
1964	3194	148	2805	169	158
1965	2734	163	2565	150	157
1966	2489	151	2118	125	139
1967	2073	154	1892	169	161
1968	1885	138	1650	127	133
1969	2471	111	2187	139	125
1970	2677	183	2291	157	171
1971	2757	170	2317	138	156
1972	2666	146	2121	103	127
1973	2612	92	2348	60	77
1974	2175	82	2441	201	145
1975	2537	110	1947	87	100
1976	3086	127	2665	119	123
1977	2463	152	1906	129	142
1978	1979	146	1869	192	168
1979	1326	140	1221	89	115
1980	2030	178	1802	116	149

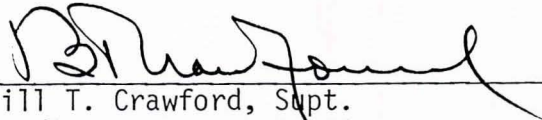
Data and Reports:

Original data and related reports in this investigation are on file in the Federal Aid Office of the Missouri Department of Conservation, Columbia, Missouri 65201

Prepared By:


Donald M. Christisen
Project Leader

Approved By:


Bill T. Crawford, Supt.
Wildlife Research Section

Date:

April 1, 1981


Dean A. Murphy, Chief
Wildlife Division


Charles A. Purkett, Jr.
Assistant Director